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Urbanisation of the Common Wood Pigeon *(Columba palumbus)* in Southeast Hungary and its impact on the population of Eurasian Collared Dove *(Streptopelia decaocto)*

András István Csathó[1] & László Bozó[2]*

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Abstract The Common Wood Pigeon (*Columba palumbus* Linnaeus, 1758) has very large populations in the European cities. However, the urbanisation of the species in the Maros–Körös köze region (Maros–Körös Interfluve) is recent and is happening before our eyes. In our study, we summarized our observations on the urbanised populations of the species in the region. Populations of the species in populated areas are currently spreading rapidly in the Maros–Körös köze region. In the past, it was a breeding species in the landscape of suburban areas far from populated areas. In recent years, it has appeared in towns and villages. It did not gradually arrive from the outer area of the settlements towards the interior of populated areas, but it was precisely in the park areas of the centres of settlements that the first pairs in these areas appeared and spread outwards. During the study, we also surveyed the nesting populations of the Eurasian Collared Dove (*Streptopelia decaocto* [Frivaldszky, 1838]) in the sampling areas, using the same methodology, so that we could also examine the proportion of both urbanised species. The population of that species was decreasing during the study period. The pairs of Common Wood Pigeons were more common in the central, more parked parts of the settlements, while the Eurasian Collared Dove was mainly found in peripheral areas. The increase in the population of the Common Wood Pigeons will cause major problems for agriculture, for which there is no solution at present.

Keywords: Columbiformes, Columbidae, tawns, settlements, urban fauna, Tiszántúl region, Great Hungarian Plain

Összefoglalás Az örvös galamb (*Columba palumbus* Linnaeus, 1758) igen jelentős városiasodott populációkkal rendelkezik Európában. A faj urbanizálódása a Maros–Körös közén viszont újkeletű, napjainkban, a szemünk előtt zajlik. Tanulmányunkban az örvös galamb a régióban kialakult lakott területen fészkelő populációira vonatkozó megfigyeléseinket foglaltuk össze. A faj lakott területeken élő állományai jelenleg gyors terjedésben vannak a Maros–Körös közén. A tájban korábban a lakott területektől távoli külterületi részek fészkelő faja volt. Az utóbbi években jelent meg a belterületeken, a városokban, falvakban. Nem a külterületek felől fokozatosan érkezett a lakott területek belseje felé, hanem pont a települések központjainak parkos részein jelentek meg az első urbanizálódott párok, és onnan terjednek kifelé. A vizsgálat során a mintavételi területeken a balkáni gerle (*Streptopelia decaocto* [Frivaldszky, 1838]) fészkelő-állományát is felmértük, azonos módszerrel, így a két faj arányát is vizsgálni tudtuk. Eredményeink szerint ennek a fajnak csökkent az állománya a vizsgálati periódus során. Az örvösgalamb-párok inkább a települések központi, parkosított részein voltak jellemzőek, míg a balkáni gerle elsősorban a perifériás részeken volt gyakori. Úgy tűnik, hogy a nagyobb termetű örvös galamb a belterületeken egyre inkább ki fogja szorítani a most még általánosan gyakori balkáni gerlét.

Kulcsszavak: galambalakúak, galambfélék, városok, falvak, városi fauna, Tiszántúl, Alföld

[1] Independent researcher, H-5830 Battonya, Somogyi Béla utca 42/A, Hungary
[2] Eötvös Loránd University, Department of Systematic Zoology and Ecology, Pázmány Péter sétány 1/C., H-1117 Budapest, Hungary
** corresponding author, e-mail: bozolaszlo91@gmail.com*

Introduction

The urbanisation of birds and their adaptation to inhabited areas has probably proceeded in parallel with industrialisation (Marzluff *et al.* 2001, Evans *et al.* 2010) and is still continuing today. Nesting in cities and villages has several advantages over natural habitats. Cities have a more stable microclimate, food sources are more constant and predictable, adult birds are often under less predation pressure, and there is no possibility to control otherwise huntable species within the city (Bedő & Heltai 2003, Vuorisalo *et al.* 2003, Kövér *et al.* 2015). These advantages have led to the emergence and spread of a number of species of human-avoidant birds that used to nest in open spaces. However, the process has not occurred simultaneously for different bird species.

While, for example, the Common Blackbird *(Turdus merula)* had breeding populations in the cities already at the beginning of the 20th century (Haraszthy 2019a), this was the case for the Hooded Crow *(Corvus cornix)* only in the 1970s (Tapfer 1974, Fintha 1994), while for the Eurasian Magpie *(Pica pica)* it was only from the 1990s onwards (Haraszthy 2019c). For some species, the process started decades or even centuries ago (e.g. Western Jackdaw *Coloeus monedula*, Benmazouz *et al.* 2021), but has only intensified in recent years. These species include, among others, the Common Wood Pigeon *(Columba palumbus)*.

The Common Wood Pigeon is a polytypic species with four subspecies living today. Its range is concentrated in Europe, where it is a widespread breeder in all but the northernmost and highest areas. It also breeds in western Siberia and the Middle East, while the other three subspecies nest in the Azores, Iran and its region, and Central Asia (Baptista *et al.* 2020). Its European range has not changed significantly over the last two decades. Its global population is estimated at 26–36, while its European population is estimated at 20.45–29 million pairs, and is a least concern species. The population still increasing in most parts of Europe (Birdlife International 2022). It occurs in both natural and human-modified habitats, except in treeless landscapes, but prefers landscapes mosaic with patches of woodland and areas with tree-lines.

In Hungary, it used to be a forest-dwelling bird, but now nests in the busiest urban areas. It also colonises closed forests, but prefers forest edges (Haraszthy 2019a). Between 2014 and 2018, its nesting population was estimated at 151–166,000 pairs, almost four times the number estimated in the early 1990s (Magyar *et al.* 1998) and about one and a half to two times the number estimated between 1999 and 2002 (Hadarics & Zalai 2008). According to the most recent data, populations are three to five times denser in built-up, anthropogenic habitats than in the Kiskunság and Nyírség regions, where, incidentally, the most significant suburban populations are found at the national level (Czirák 2021a).

In Europe, it is a partial migrant. Populations in Western and Northern Europe winter in NW France, Southern Iberian Peninsula and North Africa, and nesting populations in Central and Northeastern Europe also migrate west to northwest. The Mediterranean populations are resident (Bea *et al.* 2003, Sruoga *et al.* 2005, Faragó 2009, Baptista *et al.* 2020). The Hungarian population is also migrating in a southwestern direction (Faragó 2000, Bankovics 2001). It is typically present in the Carpathian Basin between early March and late October, but its migration is influenced by the weather (Molnár 1979, Főnyedi 1981, Dénes 1982,

Varga 1982, Anonymus 1993, Kárpáti 2003, Bozó & Csörgő 2020). During mild weather in spring, large flocks can be seen as early as late January – early February, while in autumn migrating Common Wood Pigeons can be seen even in early November (Faragó 2009, Czirák 2021a, Magyar Madártani és Természetvédelmi Egyesület 2022). The migration peak in spring is in March and April (Faragó 2009). The size of migrating flocks can be several hundred individuals in spring and autumn. Due to the moderating weather conditions, some individuals are now regularly attempting to overwinter, but the extent of overwintering is still very small (Czirák 2021a, Magyar Madártani és Természetvédelmi Egyesület 2022).

Like other pigeon species, such as the Eurasian Collared Dove *(Streptopelia decaocto)*, it is a highly successful species, due to a number of factors. Already in the first decades of the 20th century, it was demonstrated that Common Wood Pigeons are opportunistic, able to adapt to the feeding conditions of a given area and season (Collinge 1924–27, Colquhoun 1951, Murton *et al.* 1963, 1964, Murton 1965). Unlike most seed-eating birds, they also consume fruits and berries, such as the seeds of ivy *(Hedera helix)*, which are poisonous to other species (Snow & Snow 1988). However, these studies were largely conducted before the high intensification of agriculture, and the situation is nevertheless similar today (Ó hUallachain & Dunne 2013). Changes in agricultural practices have also benefited the species (Negrier *et al.* 2021), for example the expansion of rapeseed *(Brassica napus)* in Britain, which has contributed significantly to the species' population growth (Kenward & Sibly 1977, Lane 1984, Inglis *et al.* 1997, Gill *et al.* 1998). This has also resulted in the species posing a serious economic risk in agriculture (Tayleur 2008). In Hungary, damage by Pigeons, including the Common Wood Pigeon, was already observed in the 1970s and 1980s in agriculture, mainly on sunflower fields (Csernavölgyi 1975, Rékási 1982). This is likely to become a more serious problem in the future, as the size of migrating flocks increases with the population (Czirák 2021a). Another possible reason for the extraordinary population increase could be the breeding biology of the species, as it can settle in highly diverse habitats (Haraszthy 2019a). Climate change is also having a significant impact on the population of the species, through changes in migration behaviour (Dolenec & Dolenec 2010), which may lead to an increase in the proportion of overwinterers in the population. Birds returning earlier and leaving later, and thus an increase in the number of breeding birds annually can be observed.

It is a highly urbanising species. In some cities in Western and Central Europe, this process was already underway at the beginning of the 19th century (Glutz von Blotzheim *et al.* 1980), while in Northern Europe it only started or became intense at the beginning of the 20th century (Denmark) and in the middle of the century (Sweden). In Finland, it only became established in large cities in the 1990s (Fey *et al.* 2015). In Hungary, breeding pairs appeared in inhabited areas in the first half of the 20th century. In Kaposvár, it was already nesting in 1929 (Greschik 1929), but its significant urbanisation took place decades later, when it typically nested in floodplains and forests far from people (e.g. Jánossy & Zlinszky 1979, Mag 1980, Erős 1982, Molnár 1991). In the early 1980s, it was common along Lake Balaton. In 1981, a pair bred near a fishing hut at Balatonederics (Nagy 1981). In the same period, in Budapest, it bred only on Margit Island and in Népliget (Rékási 2000), but already then it was nesting in large numbers in the wooded areas around the city

(Ébert 1980, Kalivoda 1986, 1990). It only became more urbanised in the 1990s: in Vác in 1990 (Drexler 1995), in Kömlő in 1993 (Ambrus 1996), in Foktő in 1994 (Sipos 1995), and by the 2010s it was nesting in all inhabited areas, including the busiest areas of Budapest (Haraszthy 2019a). However, this phenomenon was not common, as in the mid-1990s it did not bred in Debrecen (Fintha & Szabó 1995) or in the cemeteries of Szeged (Lovászi 1994). Schmidt (1994) published a call for the documentation of the urbanisation of the species, and also pointed out that the behaviour of "wild" and "urban" birds differs significantly. While forest-dwelling individuals are extremely shy and avoid humans, individuals breeding in the cities have become extremely trusting.

In Békés County, according to the literature, at the turn of the 19th and 20th centuries and until the 1930s, it did not breed in the area of Szarvas or Békéscsaba (Tarján 1930, Molnár 1942), while according to Csath (1938), a few pairs bred undisturbed in the forests of Doboz, Póstelek, Gyulavári and Gyomaendrőd. Spring migration also occurred during this period, with the first returning birds being seen in Békéscsaba on 15 March 1907 (Schenk 1908), 27 March 1919 (Schenk 1920), 8 April 1923 (Warga 1924), and in Csorvás on 20 March 1909 (Greschik 1910). Since the 1940s, nesting has been reported throughout the county, typically in arboretums and floodplain forests, but no published data are available on when urbanisation started (Bozó 2022).

A similar process took place decades ago with the Eurasian Collared Dove in Hungary, but this species is not native to Hungary, unlike the Common Wood Pigeon. The species arrived to the Carpathian Basin from the Balkan Peninsula in the 1930s. After several alleged sightings, the first breeding was observed in Berettyóújfalu in 1932. In 1934, it was found in Székesfehérvár, in 1935 in Derecske and Bicske, in 1936 in the vicinity of Budapest, Lake Balaton and Komárom, and in 1937 it became common in these areas. Continuing its expansion towards the northeast, it slowly spread throughout the country (Keve-Kleiner 1944, Keve 1947). However, even in the early 1950s, there were still a few settlements in the country where it did not bred (Keve 1962). Its urbanisation started in the mid-1940s and proceeded at a rapid pace (Keve 1947, Tomasz 1955). Today it nests mainly in populated areas (Czirák 2021b), but in some large cities the population has declined in the city centre for various reasons (Varga & Juhász 2020).

In the last few years we have observed that the nesting population of the Common Wood Pigeon has increased spectacularly in the southern part of Békés County. Given that we have recorded the date of the first pairs breeding in the inhabited areas in several settlements of the region, we thought to survey the population of the Common Wood Pigeon in the central part of some settlements in 2022. In our work, we were mainly interested in the extent to which the population had increased in recent years. We also examined whether the population increase of this species has affected the population of the Eurasian Collared Dove, which occurs in similar habitats. This is an interesting question, because during the urbanisation of the Eurasian Collared Dove in the early period, it was found to share habitats with the Turtle Dove *(Streptopelia turtur)*, and the nesting areas of the two species were well separated (Keve 1947). Hunting data were also used, as they provide an excellent indication of the direction of population change. In addition to these data, we also report data on the migration of the species, as no detailed study has been carried out on this issue in Hungary.

Material and Methods

We chose three settlements (Mezőhegyes, Battonya, Kevermes) in the Közép-Tiszántúl, Maros–Körös köze region (Maros–Körös Interfluve) (SE Hungary) as the location of our research. In each of the three municipalities, an area of roughly the same size – approximately 31–37 hectares – was selected for the survey as follows. In Mezőhegyes, Vörösmarty street and Kiskatonák square, Kossuth street, the railway track and Posta street (31.2 hectares), in Battonya, Puskin street, Táncsics Mihály street, Állomás street and Hunyadi János street (36.9 hectares), while in Kevermes the area delimited by Battonyai street, Jókai street, Toldi street, Kossuth street, Felszabadulás street and the sports field (36.9 hectares).

Given that both species are easily recognisable by both vocal and visual observation, the survey was carried out using simple field observations. We considered birds as nesting pairs that were moving, singing or perching in a well-defined area. Maps were created of the nesting pairs found during the surveys. Surveys were conducted on 8 and 9 April in all three settlements in sunny, calm weather. In Mezőhegyes, we surveyed the area late in the afternoon on 8 April, in Battonya from dawn to mid-morning and late afternoon on 8 April, and in Kevermes late in the afternoon on 8 April and early morning on 9 April.

Since data on the dates of the appearance of the Common Wood Pigeon as a nesting species were available for the respective sites, we also reported them.

We have also collected hunting data from the period between 1999 and 2020, because the annual shooting statistics in Békés County can also be an indicator of possible population changes. For this purpose, we used the annual reports of the National Hunting Data Repository (www.ova.hu).

The migration pattern of the Common Wood Pigeon has also changed over the last century, so it was important to process local migration data as well, so that they could serve as a basis for future country-wide studies. These data are available in Kevermes from 2005, but as standard sampling was only carried out in the area from 2012 onwards, we were only able to describe the migration (medians, start and end dates) from that time onwards. For the calculation of the median dates, the Past 3.14 program was used (Hammer *et al.* 2001).The spring migration period was considered to be from 1 February to 1 April, while the autumn migration period was considered to be from 1 August to 30 November.

Results

The first urbanised individuals of the Common Wood Pigeon

The first pair breeding in the city was recorded in Mezőhegyes on 3 May 2016 (but urbanised birds probably appeared some years earlier in this settlement), and in 2020 it was already common (A. I. Csathó).

In Battonya, the first urbanised Common Wood Pigeon was recorded on 2 May 2015 in the area of the Thermal Baths (A. I. Csathó & Eszter Csathó). In 2019, it was already more

widespread (A. I. Csathó), while in 2020 the population in the city continued to increase, with approximately 10 pairs breeding here (A. I. Csathó).

In Kevermes, the first, probably urbanised bird was observed in the village centre on 26 July 2014, and a bird was also observed in the same place on 10 May 2015. On 17 May 2016, an individual was seen again at a garden pond in the village centre.

On the other settlements of Maros–Körös köze region our first data of urbanised Common Wood Pigeons: Lőkösháza (22 April 2015) (L. Bozó), Szarvas (25 March 2014) (A. I. Csathó), Tótkomlós (15 April 2016) (A. I. Csathó). In 2020 the Common Wood Pigeon was already frequent in downtown area of Orosháza, the number of nesting urbanised pairs in this settlement was estimated by an order of hundreds pairs (A. I. Csathó).

Point counts

The results of the population survey by species (number of pairs and population density per settlement) are presented in *Table 1*, while the results of the point counts are presented in *Figures 1–3*. The largest nesting population and population density of the Common Wood Pigeon was in Mezőhegyes and the smallest in Kevermes. For the Eurasian Collared Dove, the same was found in Battonya and Mezőhegyes.

Table 1. Results of the population survey of Common Wood Pigeons and Eurasian Collared Doves in the three settlements in Békés County

1. táblázat Az örvös galamb és a balkáni gerle állományfelmérésének eredményei a három vizsgált Békés megyei településen

		Mezőhegyes	Battonya	Kevermes
Area of the sampling unit surveyed (hectare)		31.2	36.9	36.9
Common Wood Pigeon	Number of nesting pairs	35	16	7
	Population density (number of nesting pairs/hectare)	1.12	0.43	0.19
Eurasian Collared Dove	Number of nesting pairs	6	48	30
	Population density (number of nesting pairs/hectare)	0.19	1.3	0.81

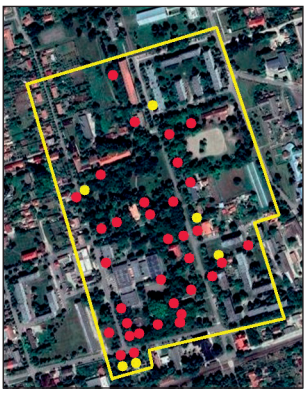

Figure 1. The results of the point counts in Mezőhegyes. Yellow line indicates the study area, red dots the mapped nesting pairs of Common Wood Pigeons, and yellow dots the mapped pairs of Eurasian Collared Doves

1. ábra A pontszámlálás eredményei Mezőhegyesen. A sárga vonal a vizsgálati területet, a piros pontok felmért fészkelő örvösgalamb-, a sárga pontok pedig a balkánigerle-párokat jelölik

Figure 2. The results of the point counts in Battonya. Yellow line indicates the study area, red dots the mapped nesting pairs of Common Wood Pigeons, and yellow dots the mapped pairs of Eurasian Collared Doves

2. ábra A pontszámlálás eredményei Battonyán. A sárga vonal a vizsgálati területet, a piros pontok felmért fészkelő örvösgalamb-, a sárga pontok pedig a balkánigerle-párokat jelölik

Figure 3. The results of the point counts in Kevermes. Yellow line indicates the study area, red dots the mapped nesting pairs of Common Wood Pigeons, and yellow dots the mapped pairs of Eurasian Collared Doves

3. ábra A pontszámlálás eredményei Kevermesen. A sárga vonal a vizsgálati területet, a piros pontok felmért fészkelő örvösgalamb-, a sárga pontok pedig a balkánigerle-párokat jelölik

It can be concluded that the nesting population of Common Wood Pigeon showed an aggregated distribution in the sampling areas. More pairs were breeding in the central, more parked areas of the settlements. The Eurasian Collared Dove was clearly more abundant in the non-central, less parked parts of the settlements. During the field survey, it appeared that for the latter species, pairs preferred common spruce *(Picea abies)* and Colorado spruce *(Picea pungens)* trees for nesting.

Hunting data

The shooting data for Békés County between 1999 and 2020 are shown in *Figures 4–5*. The number of birds shooted increased significantly over time for the Common Wood Pigeon ($R = 0.81$, $P < 0.0001$), while the number of birds shooted for the Eurasian Collared Dove did not change significantly over time ($R = 0.0305$, $P = 0.44$). When the same is calculated for the period 2011–2020, there is a similar significant increase for the Common Wood Pigeon ($R = 0.82$, $P = 0.003$), but a significant decrease for the Eurasian Collared Dove ($R = -0.87$, $P = 0.001$).

Migration data of Common Wood Pigeon

For the area of Kevermes and Lőkösháza, we have observation data for a total of 1,148 different days between 1 January 2005 and 12 May 2022. Statistics describing spring and

Figure 4. Hunting data of the Common Wood Pigeon for the period 1999–2020 in Békés County
4. ábra Az örvös galamb vadászati statisztikákban szereplő terítékadatai 1999 és 2020 között Békés megyében

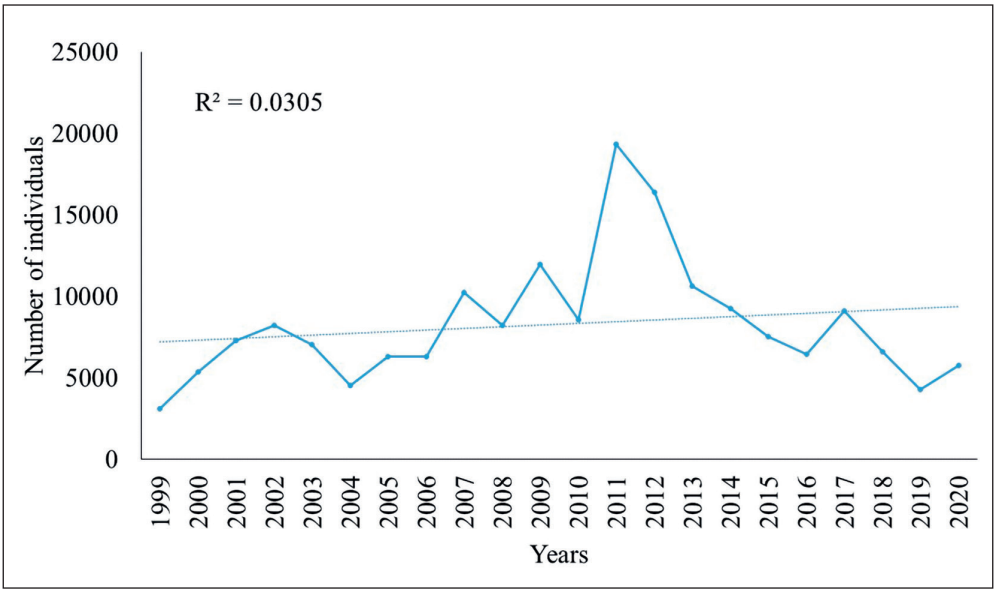

Figure 5. Hunting data of the Eurasian Collared Dove for the period 1999–2020 in Békés County
5. ábra A balkáni gerle vadászati statisztikákban szereplő terítékadatai 1999 és 2020 között Békés megyében

autumn migration between 2012 and 2022 are presented in *Table 2*. On average, the spring migration started on 24 February (SD = 9.4 days), ended on 5 April (SD = 2.1 days) and had a length of 40 ± 8.8 days. Autumn migration started on average on 16 September (SD = 12.8 days), ended on 8 November (SD = 10.9 days) and had a length of 52.6 ± 17 days. It is not clearly possible to determine the exact end of spring migration and the beginning of autumn migration due to the presence of nesting birds. These dates coincide with the appearance of the last flocks in spring and the first flocks in autumn. Migration peaks could not be determined in either period, but the highest numbers migrated in the area between the end of March and the first week of April in spring and the first half of October in autumn.

Taking data from 2005 to 2022, the earliest spring occurrence is from 14 February 2014, while the latest autumn occurrence is from 22 November 2014.

In spring, they typically migrated in small groups of 10–15 individuals, but groups of several hundred individuals were also common. Groups larger than 200 individuals (200–400, possibly 1,000–1,500 individuals) were recorded in seven cases, all during late March. The largest flock of about 1,500 was seen on 20 March 2017 at the former pheasant farm in Kevermes. In autumn, flocks of only a few dozen individuals were typically seen in September (occasionally as early as August), but flocks of 100 individuals or more were only seen in October. On 13 occasions, we observed groups larger than 200 individuals. The highest total number of individuals observed in one day was about 2,000 on 7 October 2017 in the vicinity of the Tábornok Forest in Kevermes.

During both migration periods, the flocks preferred quiet, undisturbed patches of woodland and woodland edges, where the only threat was the Northern Goshawk *(Accipiter gentilis)* (based on several killed Common Wood Pigeons). In these places they sometimes stayed for several days (up to a week or two in autumn).

Table 2. Migration data of Common Wood Pigeon from Kevermes and Lőkösháza between 2012 and 2022

2. táblázat Az örvös galamb vonulási adata Kevermesről és Lőkösházáról 2012 és 2022 között

Year	Period	First data	Last data	Length of migration period (day)
2012	spring	2 Mar	6 Apr	35
	autumn	15 Sep	26 Oct	41
2013	spring	5 Mar	8 Apr	34
	autumn	2 Oct	2 Nov	31
2014	spring	10 Febr	6 Apr	55
	autumn	12 Sep	22 Nov	71
2015	spring	7 Mar	6 Apr	30
	autumn	28 Aug	10 Nov	74
2016	spring	11 Feb	5 Apr	53
	autumn	7 Sep	25 Oct	48
2017	spring	26 Feb	7 Apr	40
	autumn	25 Sep	26 Oct	31
2018	spring	9 Mar	7 Apr	29
	autumn	1 Oct	17 Nov	47
2019	spring	15 Feb	2 Apr	46
	autumn	2 Sep	17 Nov	76
2020	spring	28 Feb	3 Apr	35
	autumn	2 Oct	16 Nov	45
2021	spring	23 Feb	2 Apr	38
	autumn	16 Sep	17 Nov	62
2022	spring	20 Feb	6 Apr	45
	autumn	–	–	

A total of 10 sightings were made during the winter period from 1 December to 31 January, seven of which occurred in December and three in January. Six individuals were sighted on 13 January 2016, otherwise all were solitary birds.

Observation data from the breeding period

The spring migration period overlaps almost completely with the breeding period of the local population, as the first spring individuals are often observed singing in the territories. At the time of the surveys in 2022, on 8–9 April, most birds were already on the nest. In one case in Mezőhegyes, the distance between two occupied nests was only 20 m. In the second half of August, we observed several nesting or singing birds in Kevermes. Urbanised birds nesting in the area are much more familiar than those nesting in the woodlands outside. Few birds regularly visit garden ponds to drink.

It is also worth noting that flocks of 20–50 individuals are now regularly found during the breeding season. This is most noticeable in late April and the first half of May, when the seeded sunflowers have hatched but the plants have not yet become strengthened. At this time, the Pigeons snip off the fresh shoots, causing damage similar to that of the European Hares *(Lepus europaeus)*. This is why the Bréda Hunting Company of Lőkösháza has already carried out a diversionary feeding in May 2022, spreading maize on the sunflower fields (István Elek – personal communication).

Discussion

Based on our data, we can conclude that urbanised populations of the Common Wood Pigon are spreading rapidly in the Maros–Körös köze region. This is so great that it is probably one of the fastest population changes of any bird species in the area.

It has bred in the area in the past, when it was a nesting species in suburban areas far from populated areas. In the 2000s and 2010s, it was ubiquitous in planted forests and woodlands in the outer area of the settlements, and was particularly found in oleaster forests (Bozó 2017). A population survey was conducted in 2000 in the outer area of Battonya, covering the entire administrative boundary (14,577 hectares). The breeding population was estimated at 32 pairs, all mapped pairs nested in the outer area of the settlement (Csathó & Csathó 2009). According to our observations, the species appeared as a breeding species in the mid-2010s in the interior, in towns and villages. The year of the first breeding of the first urbanised pair in a given locality is probably imprecise, but it is still important to document it as soon as possible, because the later we try to estimate it, the more imprecise it becomes. Our data are more accurate for Battonya and Kevermes because the avifauna of these settlements has been monitored continuously over the last decades. However, it is a fact that the first breeding pairs in the study area appeared much later than the urbanisation pattern of the species in Hungary. In the nearest large cities, such as Szeged, Békéscsaba and Orosháza, we have observed earlier appearances, but abundant breeding is now taking place in these settlements. The reason why it appears

later in our area is probably due to the lower population size of the municipalities in the region and the smaller size of the park areas.

The highest population density was recorded in the largest municipality with the most parkland, Mezőhegyes, while the lowest density was recorded in the smallest and least parkland municipality, Kevermes. One of the drivers of urbanisation is predator avoidance, which may also be the case for the species. However, it is possible that the low number of (or lack of) birds of prey has led to the late appearance of the first pairs in populated areas in this region. As the area is one of the best small game areas in the country, there is very high year-round hunting pressure on predators, so there is no evidence of nesting Northern Goshawks in the area, for example.

It is very important to underline that the first urbanised pairs did not gradually arrive from the outer area of the settlements towards the interior of populated areas (i.e. not in a centripetal direction), but rather appeared in the park areas of the centres of the settlements and spread outwards from there. Thus, the rapid spread of the species in recent years is even more striking.

The rapid population growth of the species in the cities, in addition to its extraordinary adaptability in terms of both breeding and feeding biology, is certainly helped by the fact that it can be hunted between 15 August and 31 January (www.omvk.hu). However, this cannot take place inside inhabited areas, so settlements provide protection for the birds. For the time being, this may be a less important driver of urbanisation, as it rarely appears in inhabited areas beyond the breeding season, but in the longer term it may be an important factor in the process.

The impact of climate change on the migration of the Common Wood Pigeon has already been demonstrated in the region (Bozó & Csörgő 2020), and this is likely to contribute not only to the earlier spring arrival of the species, but also to its urbanisation. Overwintering has not yet been observed in the region, but some mid-winter data may already predict future overwintering.

Our observations suggest that the species' population in the outer area of the settlements is stable rather than increasing. These birds are still much more shy than birds in the cities and villages and will take off immediately when approaching a nest or a feeding individual. The increasing damage in agricultural areas is therefore more in line with the exponential increase in the population in inhabited areas than with the stability of the population in the outer area of the settlements. Damage in agriculture was already occurring, but the increase in biomass in recent years has created increasingly tense situations. This will most certainly become even more problematic in the future, and it is a good question whether the early summer damage on sunflower fields, for example, can be contained within the legal framework.

At the time of the survey, it was clear that the Common Wood Pigeon was competing with the also urbanised and large populations of the Eurasian Collared Dove, and that the populations of the smaller dove would decline, if not in the near future. We do not have precise figures on how many pairs of Eurasian Collared Dove were breeding in the inhabited areas of the region even a decade ago, but it is very likely that many more than the number of pairs counted now. In Battonya and Kevermes, the two less parkland settlements, the

Eurasian Collared Dove still nests in greater numbers than the Common Wood Pigeon, but in the centre of Mezőhegyes the larger species has clearly dominated. It is clear that the Eurasian Collared Dove is being displaced from the central, parked areas to the garden streets of villages and towns, and is now also becoming more common in the open outer areas of the settlements, on the edges of forest patches and in tree-lines (Bozó 2017). A decline in the population of the species in the city centre and a parallel displacement to peripheral areas were also observed in Debrecen. Here, a density of 94.5 pairs/10 ha was recorded in the 1980s, but between 2016 and 2020 this figure was less than halved to 37.45 pairs/10 ha, while the density of breeding population in peripheral areas doubled. The reason for this change was that the food supply of the species decreased due to the bankruptcy of mills in the city (Varga & Juhász 2020).

The process seems to be taking place between the two species as between the Eurasian Collared Dove and the European Turtle Dove in the mid-20th century. At that time, the rapid spread of the Eurasian Collared Dove triggered a division of territory between the two species: the European Turtle Dove was confined to the outer area of the settlements and parks, while the other species became the "bird of the gardens". In the places where they bred side by side, there were often conflicts between the two species, with one or the other emerging victorious (Keve 1947). However, the difference in body size between the two species is not nearly as great as between the Common Wood Pigeon and the Eurasian Collared Dove, so it is understandable that the latter's distribution is dictated by its spread.

In Hungary, the Eurasian Collared Dove can nest in a wide variety of habitats, but it builds its nest mostly in the cover of evergreens (Haraszthy 2019b). We observed this, as in most cases we saw singing individuals in places where there was some kind of evergreen tree.

It should be noted that in Battonya, and especially in Kevermes, the European Turtle Dove has also become urbanised in recent years. In Kevermes, for example, they are already breeding in the centre of the village (L. Bozó pers. obs.). However, the reason for this is clearly the increasing number of unoccupied houses and empty plots of land, which are growing year by year due to the unfavourable demographic conditions, creating an excellent habitat for the species. Even in the first half of the 20th century, nesting in the cities was not unprecedented for the European Turtle Dove (Dorning 1928, Balassa 1930).

The increase in the population of the Common Wood Pigeon since the mid-2010s is paralleled by hunting data. This trend has been visible since the late 1990s. In the case of the Eurasian Collared Dove, however, the distribution data from 1999 to 2020 and from 2011 to 2020 show a different trend. Until the 21-year period, there was no change in the number of birds shot annually, while in the last 10 years have seen a significant decrease. Both the stability and the decline are interesting, as the most recent national data show that the population of the species in Hungary has been increasing steadily, and this has become even more intense in the last period (Czirák 2021b). The decline could be related to the spread of the Common Wood Pigeon, but it cannot be excluded that some local, unknown effect is behind it.

In relation to the migration data, it is worth noting that there have been no multi-year studies at regional level from the other parts of the country, so our own results can only be compared with the national data. However, the timing of the migration is similar to the national average (Faragó 2009, Czirák 2021a). Groups of several hundred, sometimes thousands of individuals are not unprecedented in Hungary (Orbán & Kovács 1985, Hadarics 1997, Hadarics 1998a, 1998b), so the observed flocks of this size in the region are not exceptional. The question is whether they will become common in the future.

In conclusion, the explosive urbanisation of the Common Wood Pigeon has only just begun in the study area, so further population increases are expected in the coming years. At the same time, the Eurasian Collared Dove is expected to become increasingly displaced to the periphery of settlements. One reason for displacement could be that they have similar lifestyles, but the Common Wood Pigeon is stronger, larger and therefore a stronger competitor. It is already apparent that the Common Wood Pigeon will cause significant damage to agriculture, but we do not yet know what the solution to this problem will be. It will also be worth keeping an eye on the populations in the outer area of the settlements, as it is an interesting question whether their size will change over time.

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